

**A new species of the genus *Donaciella* from the Lower Pleistocene
in Nagaoka City, Niigata Prefecture, central Japan
(Coleoptera: Chrysomelidae: Donaciinae)**

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新潟県長岡市の魚沼層から産出した
前期更新世の*Donaciella*属の新種
(鞘翅目: ハムシ科: ネクイハムシ亜科)

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抄録: 新潟県長岡市西部の上部魚沼層から現在の日本には分布しないネクイハムシ亜科の化石が産出した。化石の年代は約80万年前である。本種は上翅の間室に微細な点刻が密集するなどの特徴を持つ。現生の*Donacia*属や*Donaciella*属の標本との比較に基づき再検討した結果、絶滅した未記載種であることが明らかになった。本論文では新種ナガオカネクイハムシ*Donaciella nagaokana* sp. nov.として記載し、本種の生物地理学的な意義と古生態について議論した。

Abstract: A fossil species of the donaciine beetle was obtained from the Upper member of Uonuma Formation in Aobadai, Nagaoka City, Niigata Prefecture, central Japan. The fossil age is about 0.8Ma. This species is characterized by the presence of dense and fine pronotal punctation, prominent pronotal calli, rugulose and densely punctulated elytral intervals, and metallic coloration. It appears to be undescribed and extinct according to comparison with the extant species. In this paper, I describe it as a new species, *Donaciella nagaokana* sp. nov., and discuss its biogeographical significance and paleoecology.

Key Words: Donaciinae; *Donaciella*; fossil; new species; Early Pleistocene; Uonuma Formation; biogeography; paleoecology

The donaciine beetles belong to the subfamily Donaciinae of the family Chrysomelidae and about 20 species of three genera are distributed in Japan. It is well-known that many donaciine fossils have been found from peaty beds of Pliocene to Pleistocene deposits. Most fossils from the middle to late Pleistocene are identified with the extant species (e.g. Fossil Insect Research Group for Nojiri-ko Excavation, 1987; Yokohama Research Group, 1987; Hayashi, 1995), but the early Pleistocene fauna of Japan includes several extinct species in Japan (Hayashi, 1996, 1997).

Hayashi et al. (1996) reported an extinct species of the genus *Donacia* from the latest Early Pleistocene donaciine fauna of the Uonuma Formation in Nagaoka City, Niigata Prefecture, Japan. However, pronotal and elytral characters of the species suggested that an extinct species was not assigned to the genus *Donacia*. I have compared the fossil species with the extant ones from Palaearctic and Nearctic regions in detail, and found that it was undescribed species of the genus *Donaciella*. In this

paper, the description of species is made and its biogeographical significance and paleoecology are discussed.

Materials and observation methods

Most fossil specimens are preserved in the closed cases with ethyl alcohol and glycerin to keep wet condition. These fossils and living specimens were examined under binocular microscope. The microstructure of elytral intervals of a dried fossil and several living specimens were observed by a scanning electron microscope (SEM).

Most living specimens examined in this study are deposited in the Osaka Museum of Natural History, and other specimens are in the collection of National Science Museum in Tokyo, in the Kanagawa Prefectural Museum of Natural History in Odawara and in the author's collection. All fossil specimens reported by Hayashi et al. (1996) are deposited in the Nagaoka Municipal Science Museum. The type

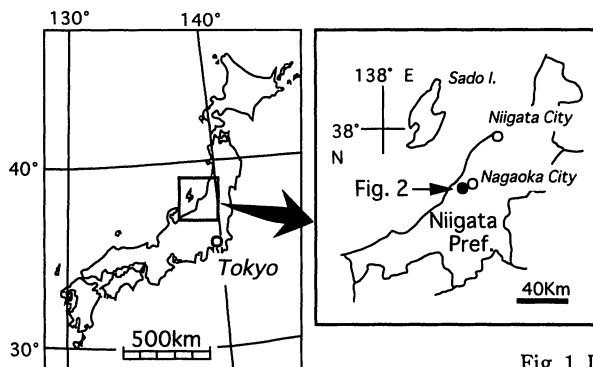


Fig. 1. Index map of the fossil locality.

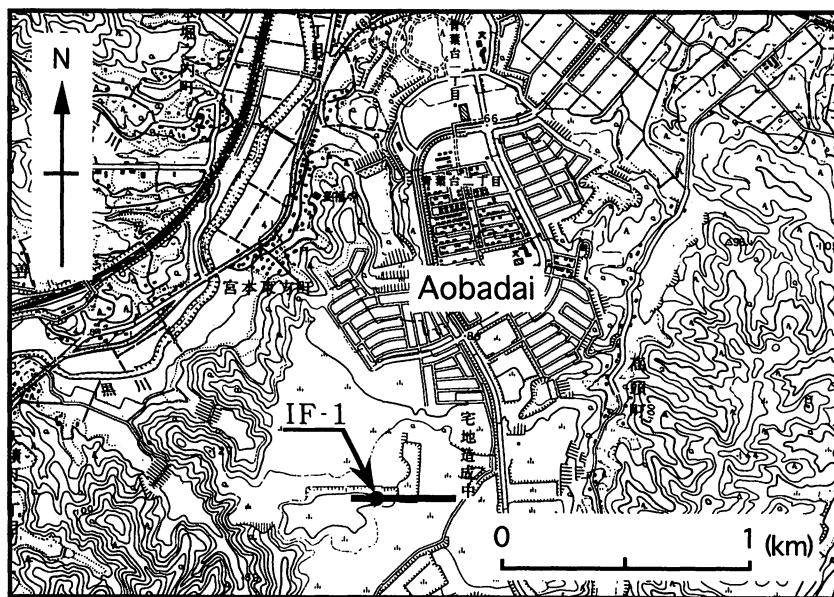


Fig. 2. Map showing the locality of "IF-1" in Aobadai. Using the topographic maps "Nagaoka" and "Nishiyama", scale 1:25,000 by the Geographical Survey Institute.

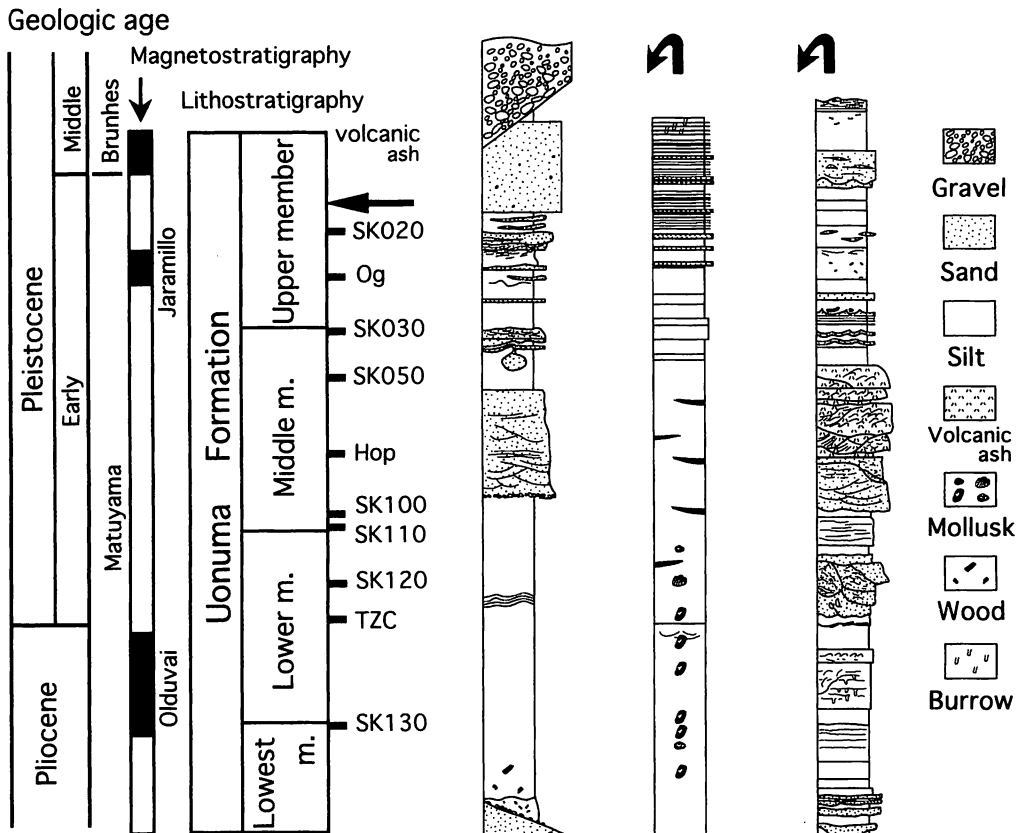
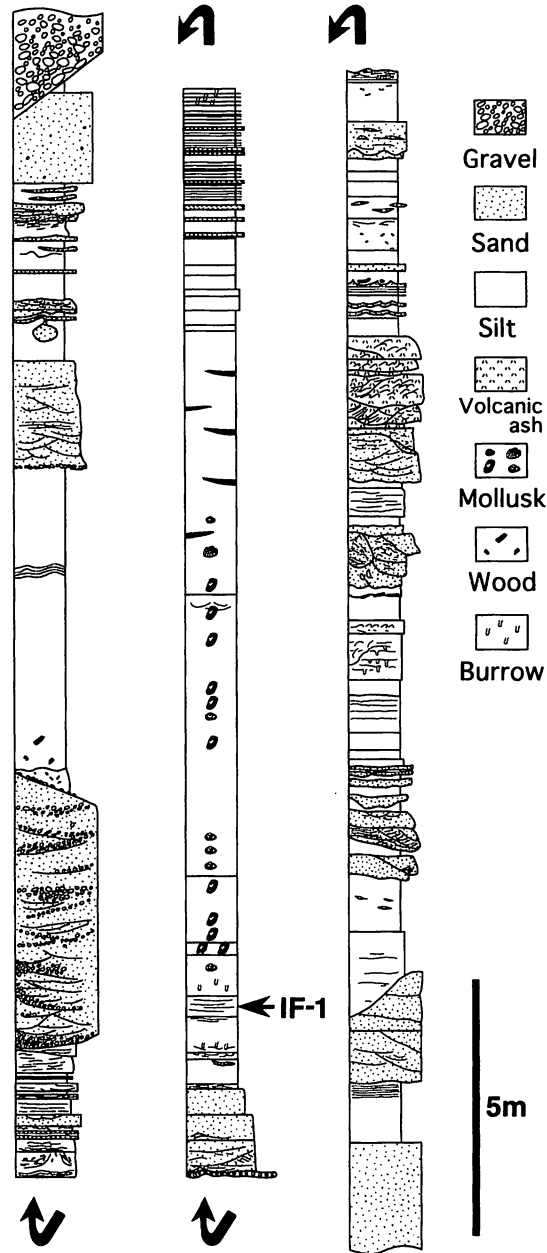


Fig. 3. Litho-, Magneto-, and Tephro-stratigraphy of Uonuma Formation (modified after Kobayashi et al., 1989 and Yoshikawa et al., 1994). The arrow showing fossil horizon.

Fig. 4. Columnar section of the upper member of Uonuma Formation in fossil locality (modified after Research Group for Depositional Environments of Uonuma Formation, 1996). "IF-1" showing fossil horizon.



series of the new species including the holotype and four paratypes are deposited in the Osaka Museum of Natural History.

Geological setting

The Uonuma Formation is widely distributed in the Higashikubiki and Uonuma hills,

southern part of the Niigata sedimentary basin, and about 2,500m in the total thickness. The formation contains many characteristic volcanic ash layers which are useful for correlation (Kazaoka, 1988; Kobayashi et al., 1989). The formation is composed of fluvial and marine deposits which is divided into four members of Lowest to Upper member, on the basis of its facies and volcanic ash layers (Uonuma Hills Collaborative Research Group, 1983; Kobayashi et al., 1989). The formation is correlated with the Osaka Group in Kinki region and the Kazusa Group in Boso region, based on the correlation of several volcanic ash layers and magnetostratigraphy (Yoshikawa et al., 1994, 1996; Tomita and Kurokawa, 1994). The geologic age of the formation is assigned to the Late Pliocene to earliest Middle Pleistocene (Yoshikoshi, 1983; Muramatsu, 1983; Yoshikawa et al., 1994).

The donaciine fossils described in this paper, were collected from the peaty beds intercalated with the Upper member of Uonuma Formation in Aobadai, Nagaoka City, Niigata Pref. (lat. 37° 21' N, long. 138° 45' 50" E: Figs. 1, 2). The fossil horizon is situated above the SK020 volcanic ash layer of Upper member of the Uonuma Formation and mainly composed of shallow marine and fluvial deposits (Yasui et al., 1983; Kobayashi et al., 1991; Fig 3). The analysis of the fission track age of the SK020 volcanic ash shows $0.81 \pm 0.12\text{Ma}$ (Muramatsu, 1983). The strata exposed in the fossil locality have yielded many fossils, such as marine mollusks, insects, plants, and diatoms (Research Group for Depositional Environments of Uonuma Formation, 1996). The donaciine fossils are obtained from IF-1 bed shown in Figure 4. The age of this fossil horizon is estimated to about 0.8Ma, based on magnetostratigraphy and fission track age of the volcanic ash (Research Group for Depositional Environments of Uonuma Formation, 1996).

Systematic description

Order Coleoptera

Family Chrysomelidae

Subfamily Donaciinae

Genus *Donaciella* Reitter

***Donaciella nagaokana* sp. nov.**

(Japanese name: Nagaoka-nekui-hamushi)

(Figs. 5A-5C, 6A-6D, 7H)

Diagnosis

Pronotum with densely punctulated disc, prominent anterolateral calli, deep callosal sulci, and fine median line. Elytra with rugulose and densely punctulated intervals.

Description

Coloration. Most specimens of pronotum and elytra entirely metallic green, more or less dull.

Pronotum. General outline more or less quadrate; anterolateral calli prominent, callosal sulci deep; postlateral parts swollen; disc densely punctulated; basal sulcus shallow but evident; median line fine.

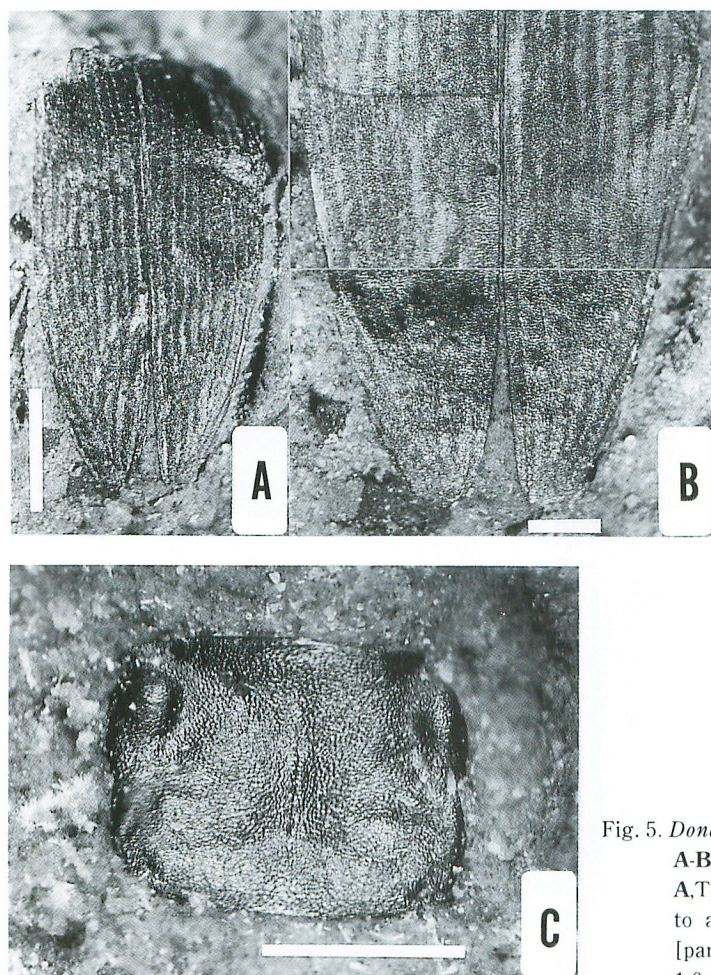


Fig. 5. *Donaciella nagaokana* sp. nov.

A-B, Elytra [holotype OMNH-TI-73]. A, The general view of elytra. B, Middle to apical area of elytra. C, Pronotum [paratype OMF-960616-003]. Scale bar: 1.0mm in A; 0.5mm in B.

Elytra. Sides subparallel from base to middle and gradually narrowing towards apex; with 10 complete punctate striae and a scutellar striole; all intervals rugulose and densely punctulated; sutural interval gradually narrowing to apex; strial punctures small; width of interval variable; apex widely truncate, outer apical angle obtuse, inner apical angle nearly right.

Measurements

Pronotum. Length 1.3-1.5mm. (n=2)

Elytron. Length 7.5mm., Width 1.7mm., L:W ratio 4.41. (n=1)

Type series

Holotype. Elytra [OMNH-TI-73: Figs. 5A-5B]. (in coll. of OMNH: Osaka Museum of Natural History, Nagai Park 1-23, Higashi-sumiyoshi-ku, Osaka, 546-0034 Japan).

Paratypes. Pronotum [OMF-960616-003: Fig. 5C], Pronotum [OMF-090616-002], Pronotum and Elytron [OMF-960616-004], Elytron [OMF-960825-001: Figs. 6A-6D, 7H]. (in coll. of OMNH)

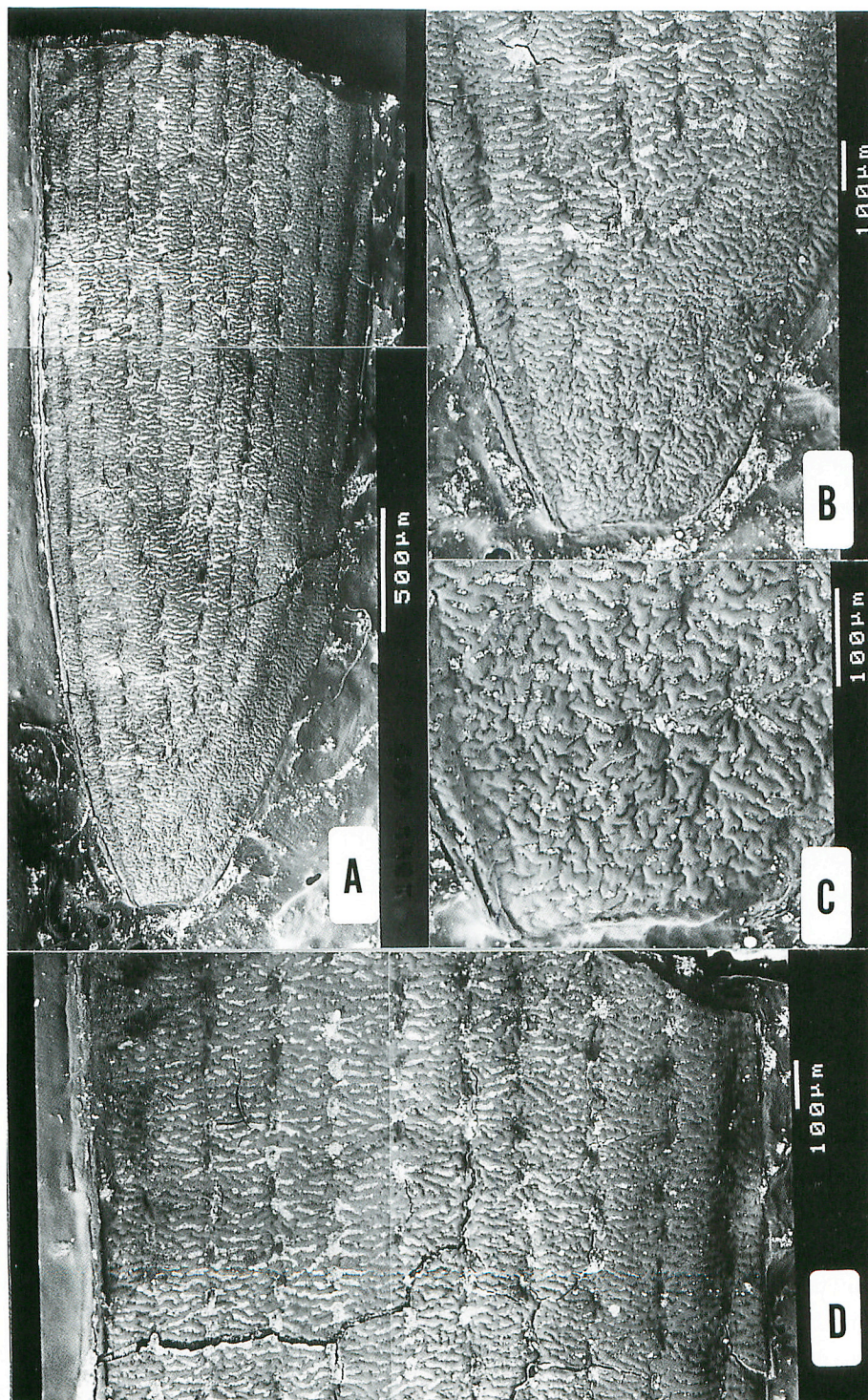


Fig. 6. *Donaciella nagaokana* sp. nov. (photograph by SEM) A-D, Right Elytron [paratype OMF-960825-001].
A, General view (lacking basal to middle area); B-C, Apical area; D, Middle part.

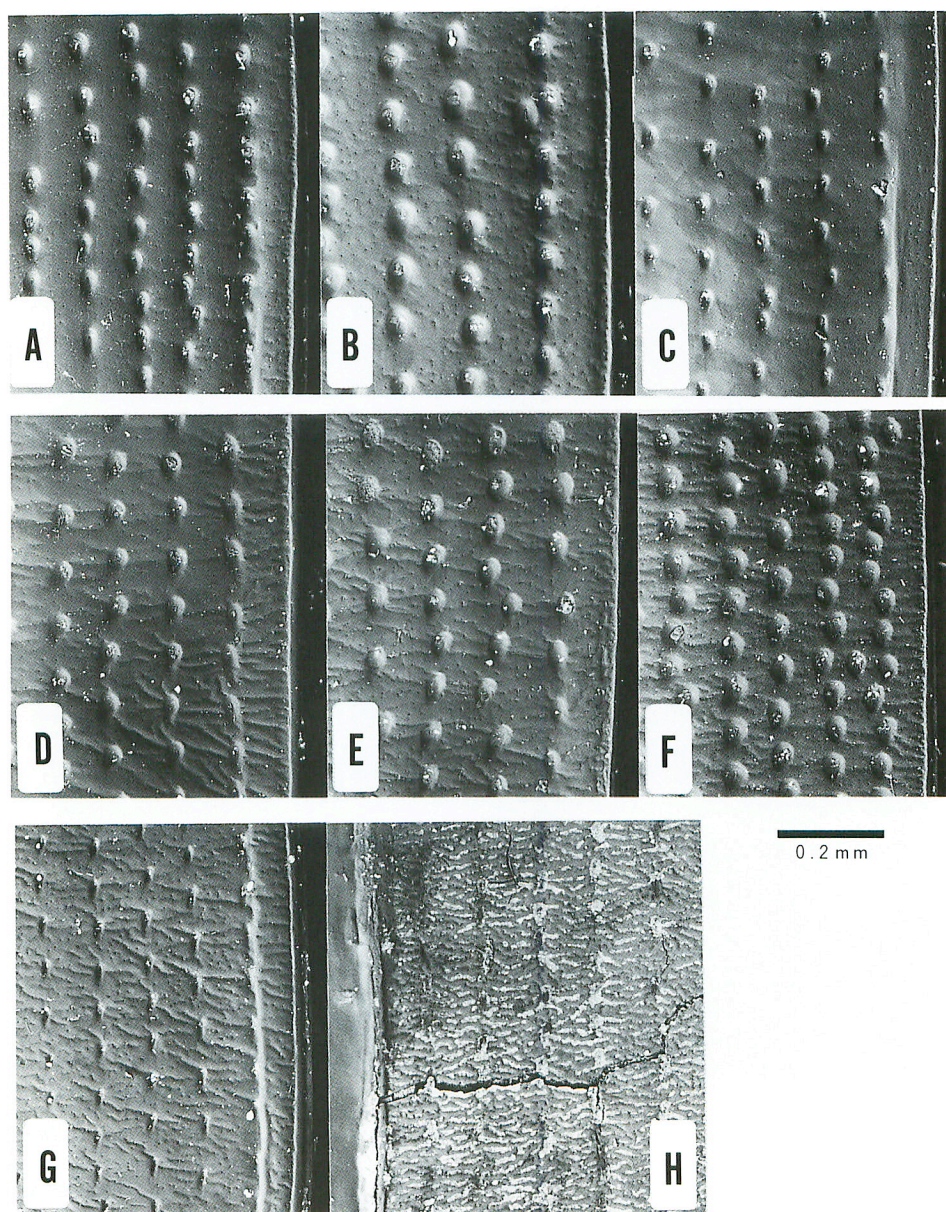


Fig. 7. Elytral sutural interval (middle part) of extant *Donacia* species and *Donaciella nagaokana* sp. nov. (photograph by SEM) A-G, Left elytron of extant male specimens. A, *D. (Cyphogaster) lenzi* (Onoda, Miyagi Pref., Japan); B, *D. (Donacia) ozensis* (Noheji, Aomori Pref., Japan); C, *D. (Donaciomima) flemora* (Misato, Ibaraki Pref., Japan); D, *D. (Donaciomima) japana* (Syowa, Fukushima Pref., Japan). E, *D. (Donaciomima) clavareau* (Urizura, Ibaraki Pref., Japan); F, *D. (Donaciomima) vulgaris* (Inawashiro, Fukushima Pref., Japan); G, *D. (Donaciomima) nitidior* (Shigaraki, Shiga Pref., Japan); H, Right elytron of *Donaciella nagaokana* [paratype OMF-960825-001]. Scale bar = 0.2mm.

Comparisons

The new species resembles members of the genus *Donacia* in its apical shape of elytron.

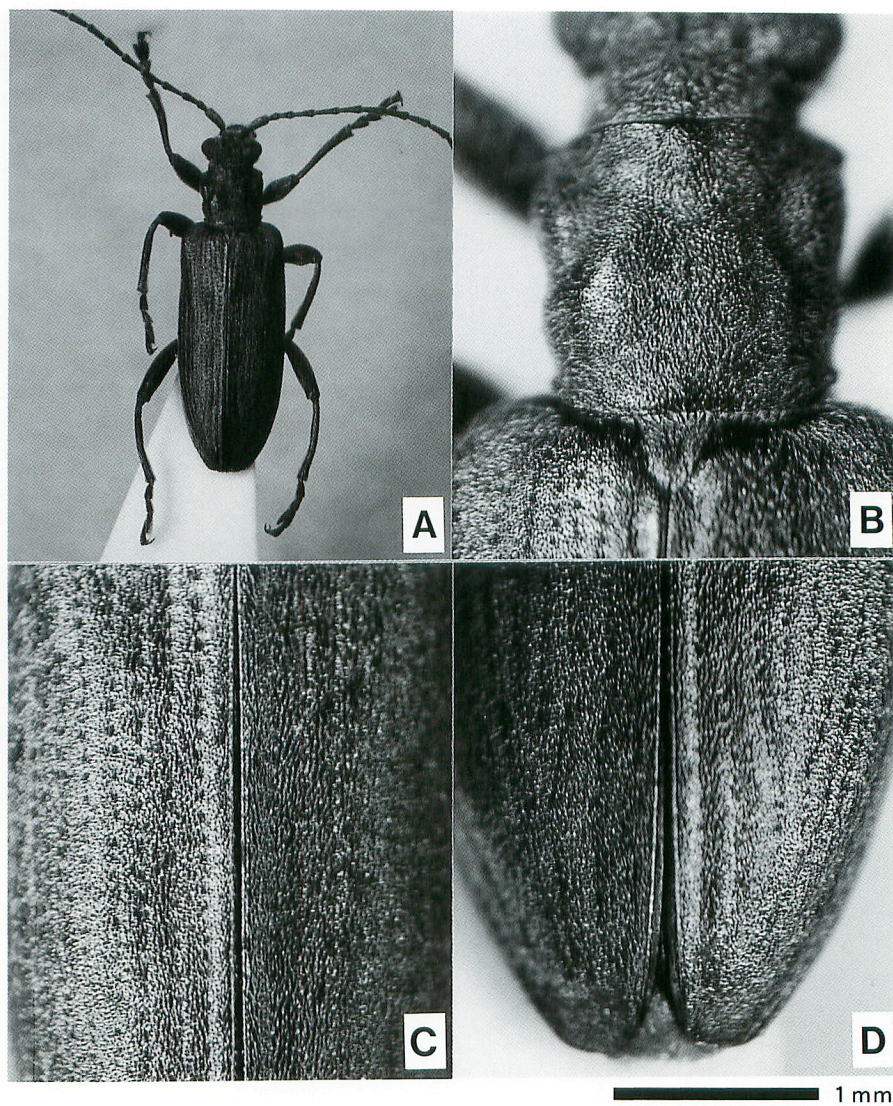


Fig. 8. A male specimen of *Donaciella cinerea* from France. **A**, general view (body length 9.8mm); **B**, Pronotum; **C**, middle part of elytra; **D**, apical area of elytra; Scale bar = 1.0mm in **B-D**.



Fig. 9. The fossil locality of *Donaciella nagaokana* sp. nov. (X) and modern distribution of *Donaciella cinerea* (data from Borowiec, 1984).

The genus *Donacia* includes three subgenera: *Cyphogaster* Goecke, *Donacia* Fabricius, and *Donaciomima* Medvedev (Askevold, 1990). Members of *Donacia* typically have elytral truncate apically, but I distinguish the new species from members of the genus by discal characters on pronotum and elytron. The subgenera of *Cyphogaster* and *Donacia* are characterized by the smooth and shiny elytral intervals (Figs. 7A, B). The subgenus *Donaciomima* includes many species, and most members of the subgenus are characterized by the coarse punctation and rugosity on the pronotal disc, and coarsely rugose elytra (Figs. 7D-7G; except for *D. flemora*: Fig. 7C). The new species has densely punctulated pronotal disc, prominent pronotal calli, rugulose and densely punctulated elytral intervals, and metallic coloration. *D. (Donaciomima) hiurai*, *D. (Donaciomima) cazieri* and *D. (Donaciomima) distincta* have rugulose intervals, but pronotal characters are different. This new species might have possessed pubescent pronotum and elytra, because punctation of the pronotal and elytral discs is very fine.

Several species of the genera of *Donacia* and *Donaciella* possess pubescent pronotum and elytra. The genus *Donaciella* includes three Palearctic and one Nearctic species which are characterized by external characters, such as elongate body and elytra, slender femora, and absent or reduced metafemoral tooth (Askevold, 1990). Especially, an European species of *Donaciella cinerea* has densely punctulated pronotal disc, prominent pronotal calli, rugulose and densely punctulated elytral intervals, and metallic coloration which is pubescent dorsally (Fig. 8). The new species is quite similar to *D. cinerea* in most characters of pronotum and elytron, but it is distinguishable from the latter by distinct median line, more prominent pronotal calli, deep callosal sulci, and truncate apical shape.

Etymology

The specific name is derived from the geographic name of the type locality.

Discussion

Biogeographic significance

The present new species, *Donaciella nagaokana* is most closely related to the European species, *D. cinerea* which is a probable sister species of that species. Only one species, *Donaciella clavipes* is known from northern China and East Siberia (Tan et al., 1980; Medvedev, 1992), but it differs from the new species in most dorsal characters. The fossil occurrence suggests that the genus *Donaciella* had been living in Japan in early Quaternary and *D. nagaokana* became extinct after the Early Pleistocene. However, it is possible that this species will be found living from rather insufficiently studied regions, because almost all Pleistocene beetles are extant (Coope, 1970, 1979; Elias, 1994). *D. cinerea* is known from Europe, Uzbekistan, northern Iran, and West Siberia (Borowiec, 1984). The modern distribution of *D. cinerea* (western Palearctic) is well removed from the fossil locality of *D. nagaokana* in Japan (Fig. 9). These distribution pattern suggests that the ancestral species was widely distributed in Eurasia and that it separated into two species before the Pleistocene.

Probable paleoecology

Five donaciine species, *Donaciella nagaokana*, *Donacia japana*, *Donacia vulgaris*?, *Donacia clavareau*?, and *Plateumaris* sp. were found in the fossil assemblages. Among them, *D. japana*, *D. vulgaris*, and *D. clavareau* mainly use emergent plants of *Sparganium*, *Typha*, and *Scirpus* (Fossil

Insect Research Group for Nojiri-ko Excavation, 1985). The European species of *D. cinerea* also uses emergent plants of *Typha* (Borowiec, 1984). The host-relationship of these species indicates that the *D. nagaokana* might have used the emergent plants, such as *Typha*. Some plant fossils of *Trapa macropoda* and *Alnus japonica* were also found in the fossil assemblages (Research Group for Depositional Environments of Uonuma Formation, 1996). The donaciine and plant fossil occurrence indicate that the paleoenvironment included areas of still water accompanied with floating-lived plants, emergent plants, and marshy trees. The new species might have lived in that environment.

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